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ACTUAL STATE OF DRAINAGE SYSTEM ON THE EXPERIMENTAL FIELD "RADMILOVAC" AND PRIORITY WORKS TO BE DONE FOR THE IMPROVEMENT OF ITS WORKING CHARACTERISTICS

Nevenka Djurović[1] and Ružica Stričević[1]

Abstract: This article represents data of the drainage system functioning at the experimental field "Radmilovac" just after its construction and eleven years later. In the first three years of the system functioning the values of drainage discharge, water table depth and soil moisture content were in the range which characterizes satisfactorily drained soil. The absence of weed control and luxinate growth of annual and perennial weed every year, canal silting, solid waste disposal in the canal significantly reduced cross- section of the water flow and blocked the outflow of the drain pipes. Mean value of the water table is moved toward the higher value, with small dispersion around the mean value, which can be used as one indicator more to describe the reduced functioning of drainage systems. To enable the system functioning on the design level, some extra works, out of regular maintenance, should be done to revitalize the system. Some of the works should be: to excavate the silt from the canal, to reshape the canal, drainpipes leaching, to root up bushes and trees from the bottom of the canal.

Key words: drainage system, recipient, drainage functioning, water table depth.

Introduction

Experimental drainage field of 1.5 ha in size "Radmilovac", belongs to the experimental station of the Faculty of Agriculture, situated 14 km south-east of Belgrade. The type of soil is eugley. Unfavorable water status throughout the whole year excluded this area for crop production. Horizontal subsurface

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perforated plastic pipes were built up in April 1993. Thus, this soil became arable and it is successfully used in crop and fruit nursery production. Canal bottom silting was at the initial stage, which has been taken as a normal effect. Several years later, regular maintenance of the drainage system should have been done, but economical situation in our country limited any other works except essential farming. The only weed control was burning of plant dry part debris in the spring time, which caused the reduced functionality of the drainage system.

Materials and Methods

The subsurface drainage system consists of 10 drains water collectors with the total length of 736 m. Drain spacing of 10m, 20m, and 30m represents drainage treatments I, II and III, respectively. The average depth of the subsurface pipes is 0.9 m. Drain water collector outflows the water directly to the canal. The canal represents the border of the experimental field. The designed canal which receives the water from the drains is, in fact, a resectioned natural creek Radmilovac. The designed depth of the canal was from 1.6m to 2.1 m. The trapezium shape of the canal was designed to have the slope of the side of m=1:1.5 (Rudić, 1993).

In the first couple of years of drainage system functioning, variation of water table depth was being measured in the piezometric hole set-up in the middle, between two drains. Drain discharge was being measured on the representative drains by volumetric method (Djurović, 1999). During the first three years of drainage system functioning only annual weed growth was being observed.

To check the level of the actual drainage system functioning, canal depth was measured in January of 2004. By detailed review of the canal, it was found that the outlet of 9 drainpipes out of 10 are in the zone of the silted bottom. Therefore, drain discharge measurement couldn’t be done. The only parameter of drainage functioning that could be measured was ground water level. Variations of water table depth were carried out in the period January-April 2004 in the same piezometric hole as it had been done 11 years ago.

Results and Discussion

Drainage system functioning during the first three years after construction

During the first three years after construction the drainage system was functioning relatively well. The values of the drain discharge, water table depth variation and soil water status were in the range which characterizes satisfactorily drained soil. It enables the usage of eugley soil for crop and fruit nursery production for the first time. To illustrate the drainage system functioning, essential parameters which describe working characteristics of the drainage system have been set-up. A histogram of water table depth was formed. The height of the ground water level is considered as the height above the axis of the drain pipes. The histogram is one kind of estimation of density probability function which shows the range of measured values. It is easily used for mean value determination, dispersion, which is, in fact, scattering around the mean value. The histogram shows the most frequent measured value, (so called mod, which is exactly defined as a point of maximum in the function of density probability), but also the realm of possible value of the highest concentration or frequency of occurrence (Vukadinović, 1986; Dielman, 1976).

The figures 1 – 3 show that ground water height above the drains was in the range from 0 – 0.8 m with the highest frequency of occurrence at 0.5 m. In the drainage treatment III with the widest drain spacing, more frequent higher values are noticeable (0.7m, 0.8m). Fig. 4 shows the dependence between the height of ground water level (h) and drain discharge (q) in the drainage treatment I during three consecutive cold seasons (November-March) from 1995 – 1997. Besides the scattered points obtained by measuring assumed polynomial trendline of second order, is shown whose coefficients are obtained by the method of least square.

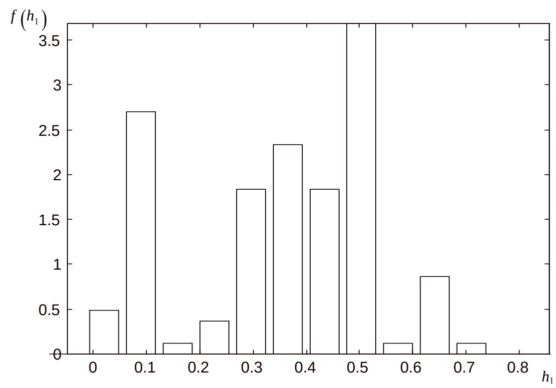

Fig. 1.- Histogram of ground water height above drain on the drainage treatment I
Note: h_1-ground water height above the drain axis on the drainage treatment I;
(h_1)-function of density probability occurrence h_1;

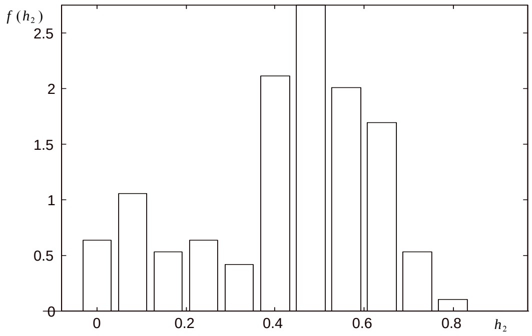

Fig. 2.- Histogram of ground water height above drain on the drainage treatment II
Note: *h2*- ground water height above the drain axis on the drainage treatment II;
$f(h_2)$- function of density probability occurrence h_2;

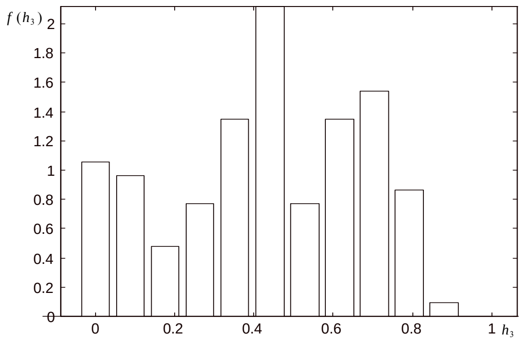

Fig. 3.- Histogram of ground water height above drain on the drainage treatment III
Note: h_3- ground water height above the drain axis on the drainage treatment III;
$f(h_3)$- function of density probability occurrence h_3;

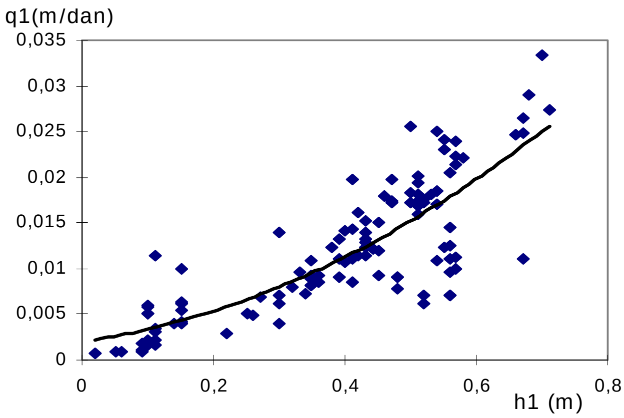

Fig. 4.- h-q curve of the drainage treatment I

From the series of measurements *h* and *q*, three subseries were separated. Each subseries represents one cold season. The aim of this analysis was to distinguish whether differences among the data of the cold seasons exist or not as well as to find out data grouping occurrence (Fig. 5). However, data for all three seasons were occuring in the wide range (0 - 0.8 m) with irregular trend. The assumption of moved statistics (mean value, median and mod) during consecutive seasons is not acceptable. On the other side, it can be concluded that in the first 3 years of drainage system functioning there were not significant differences in interacting relations on the parameters which characterize the functioning of drainage system. It means that drainage process was steady. Such results provided the possibility of being compared with the data obtained after 11 years, when monthly sums of precipitation were in the range of perennial average.

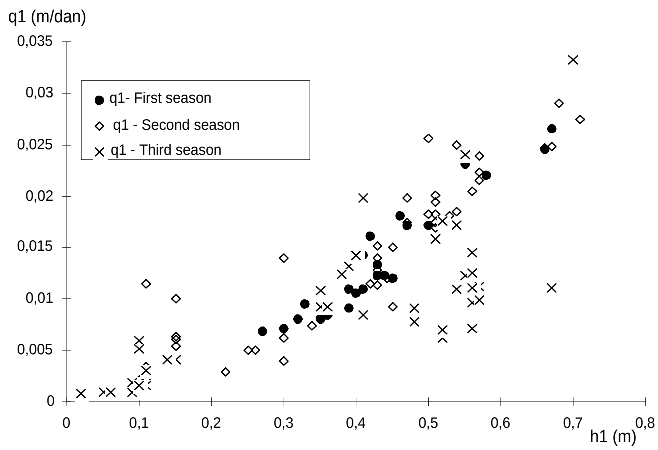

Fig. 5.- Dependence of *q* i *h* in three consecutive cold seasons in the drainage treatment I

Actual state of drainage system

According to the thorough review of drainage field in January 2004, it can be concluded that functioning of drainage system was significantly reduced. The measurement of canal depth refers to the conclusion that silting of the canal bottom was appreciable reducing the cross- section of water flow, esspecially in the lowest part of the drainage field (Fig. 6). In some canal reaches water level was near the soil surface as well as ground water table (Photo 1, 2). Besides silting, the major reasons for ruining the canals and changing of hydraulic characteristics were solid waste disposal by malpractice of people and absence of weed control, whereby luxinate growth of emersive annual weeds and perennial bushes and trees was enabled. Nine of 10 drain outlets are below the bottom of the canal. These are the main causes of drainage system malfunctioning (Fig. 6).

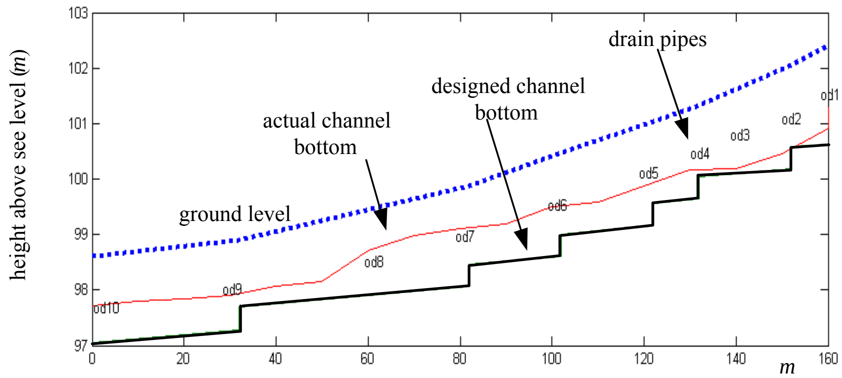

Fig. 6.- Longitudinal section of the Radmilovac canal (designed and actual bottom)

Photos 1 and 2 - Actual state of Radmilovac canal

The obtained data by measuring ground water table depth over the three drainage treatments in the period January – March show that water table depth was very shallow. It means that ground water above drains was very high, varying from 0.6 – 0.9 m (Fig. 7).

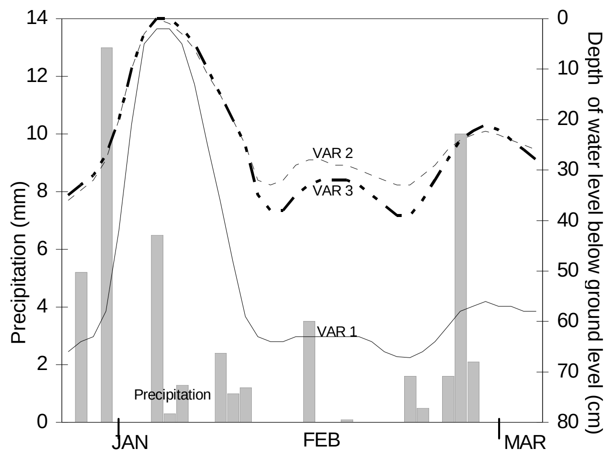

Fig. 7.- Precipitation and water table depth from the soil surface (January- March 2004)

The histogram of ground water height in the period Januar-March 2004 (Fig. 8 – 10) shows the movement of the total measuring scope toward higher values. It is less marked in the drainage treatment I, with narrower drain spacing. It can be explained by the fact that the only drain, whose outlet is above the canal bottom belongs to that treatment (Fig. 6). In the drainage treatment II and III mean value of measured ground water height is moved from 0.458 m to 0.6634 m and from 0.473 m to 0.6485 m, respectively. In the period just after the construction, when the drainage system functioning was well, the histogram was expanded with measured values of data from 0 – 0.9 m, whereas in the period January-March 2004 measured data are grouped around the value of mod and mean value. A small dispersion of data refers to a small value of variance and standard variation of 0.207 m, 0.096 m and 0.117 m, on the drainage treatments I, II and III, respectively. It can be considered as one indicator more of drainage system malfunctioning.

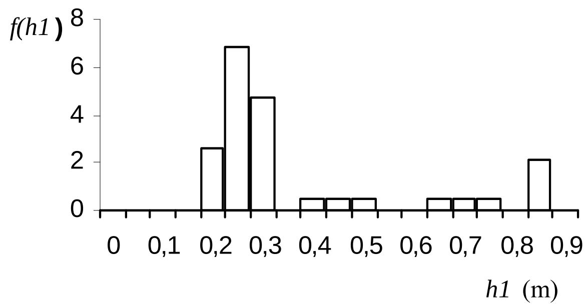

Fig. 8.- Histogram of ground water height above the drain axes on the drainage treatment I (January-March 2004)

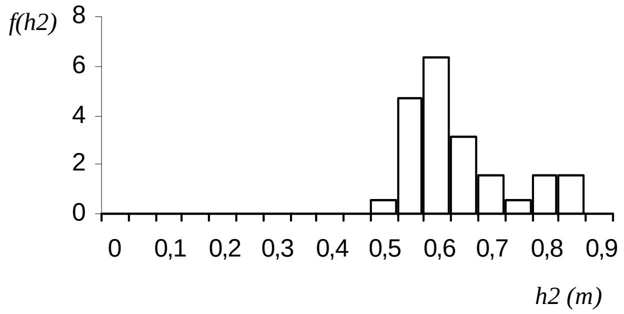

Fig. 9.- Histogram of ground water height above the drain axes on the drainage treatment II (January-March 2004)

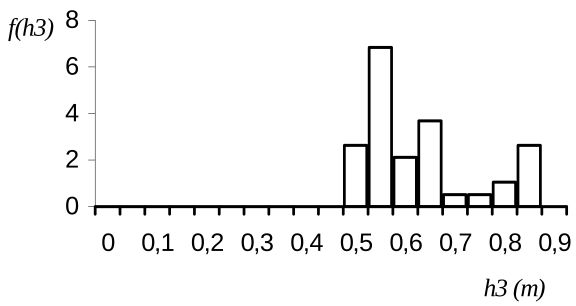

Fig. 10.- Histogram of ground water height above the drain axes on the drainage treatment III (January-March 2004)

From the obtained data it comes out that drainage field is not sufficiently drained even with the assumption that drains under unfavourable circumstances of outlet function somehow.

Conclusion

Canal which accepts the drained water from the experimental field Radmilovac has not been properly maintained. It influenced the whole drainage system mulfunctioning. The actual status of the canal was caused by luxative growth of annual and perennial weed, solid waste disposal by malpractice of people, silting of canal bottom as well as by the absence of regular maintenance. Mean value of measured ground water height is moved toward higher values with smaller dispersion of data around mean value, which can be taken as one indicator more of reduced functioning of the drainage system.

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AKTUELNO STANJE SISTEMA ZA ODVODNJAVANJE NA OGLEDNOM DOBRU "RADMILOVAC" I PRIORITETNE MERE ZA POBOLJŠANJE RADNIH KARAKTERISTIKA SISTEMA

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R e z i m e

U radu su predstavljeni uporedni podaci o funkcionisanju drenažnog sistema na oglednom školskom dobru Radmilovac u periodu posle izgradnje sistema i posle 11 godina eksploatacije. U godinama neposredno posle izgradnje vrednosti drenažnog oticaja, nivoa podzemne vode, i vlažnosti zemljišta nalazile su se u granicama koje ukazuju na zadovoljavajuće funkcionisanje sistema za odvodnjavanje. Pojave kao što su zarastanje kanala u jednogodišnje i višegodišnje rastinje, zamuljivanje profila kanala, bacanje otpadaka u kanal, zatvaranje delova proticajnog profila i druge, dovele su do smanjene funkcionalnosti sistema za odvodnjavanje Srednje vrednosti registrovanog nivoa podzemne vode pomerene su prema većim vrednostima sa malim rasipanjem podataka oko srednje vrednosti, što se može smatrati još jednim pokazateljem smanjenog funkcionisanja sistema za odvodnjavanje. Za vraćanje sistema za odvodnjavanje u prvobitno stanje potrebne su mere revitalizacije sistema koje podrazumevaju dovođenje odvodnog kanala u prvobitno stanje i ispiranje drenažnih cevi.

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